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ABSTRACT

This paper estimates the effects of freshman athletic participation on reading comprehension, mathematics, and critical thinking controlling for pre-college aptitude and other influences. A group of 3,331 students from 18 four-year and 5 two-year colleges and universities participated in initial testing during fall of their freshman year. Testing involved pre-college surveys and the Collegiate Assessment of Academic Proficiency (CAAP). Subjects (n=2,416) were given followup testing the following spring. Women and non-white students were over-represented, and nearly twice as many women participated as men. Intercollegiate athletic participation was found to have significant adverse consequences for the general cognitive development of both men and women during the first year of college. The analyses for women showed somewhat less pronounced and extensive general effects than those for men. In particular, males participating in football and basketball experienced net declines in reading comprehension and math skills during their freshman year while students in other sports and non-athletes showed net gains. The study raises questions as to the educational wisdom of allowing freshmen to participate in varsity level intercollegiate football and basketball. (Contains 40 references.) (GLR)

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INTERCOLLEGIATE ATHLETIC PARTICIPATION AND FRESHMAN YEAR COGNITIVE OUTCOMES*

ED 368 268

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Abstract

Controlling for precollege aptitude and other influences, male intercollegiate football and basketball players demonstrated freshman-year declines in reading and mathematics while non-athletes and athletes in other sports showed modest gains. Female athletes made smaller gains in reading than non-athletes, but the effect depended upon precollege ability.

INTERCOLLEGIATE ATHLETIC PARTICIPATION AND FRESHMAN YEAR COGNITIVE OUTCOMES

The role of intercollegiate athletics in college has recently become the focus of considerable discussion and debate. As suggested by Ryan (1989), the contribution of intercollegiate athletic participation to an individual's education is being questioned, not only by faculty and administrators, but also by the public news media. There is a small but growing body of evidence on the impact of athletic participation on various educational outcomes. A substantial segment of this evidence suggests that athletic participation may be negatively linked with such outcomes as involvement and satisfaction with the overall college experience, career maturity, and clarity in educational and occupational plans (e.g., Blann, 1985; Kennedy & Dimick, 1987; Sowa & Gressard, 1983; Stone & Strange, 1989). Similarly, although athletic participation in college may often function to facilitate the social mobility of individuals from relatively low socioeconomic backgrounds (e.g., Sack & Thiel, 1979), both DuBois (1978) and Howard (1986) found little to indicate that various objective indexes of career success (e.g., job status, managerial effectiveness) are significantly correlated with collegiate athletic participation.

A non-trivial problem confronting researchers attempting to estimate the educational impacts actually attributable to

athletic participation and not other aspects of the college experience (i.e., athletics' "net effect") is that intercollegiate athletes often enter college with a constellation of secondary school experiences, aptitudes, and socioeconomic perspectives that are significantly different from those of non-athletes (e.g., Hood, Craig & Ferguson, 1992; Pascarella & Smart, 1991). This means that, unless one takes such background or precollege characteristics into account, it is likely that comparisons of athletes and non-athletes will simply reflect individual differences at the time of entrance to college rather than the net effects of athletic participation during college (e.g. Astin, 1970; Pascarella, 1987; Pascarella & Terenzini, 1991). The research that attempts to control for precollege differences between athletes and their non-athlete counterparts reports positive net impacts for athletic participation in several areas. For example, analyzing different iterations of a national data base from the Cooperative Institutional Research Program, Astin (1984), Ryan (1989), and Pascarella & Smart (1991) report evidence indicating that athletic participation is linked to satisfaction with the overall college experience and may also increase motivation to complete one's degree, persistence in college, and actual bachelor's degree completion.

Interestingly, relatively little attention has been paid to the impacts of athletic participation on the various cognitive outcomes of college. The evidence that does exist focuses largely on the impact of being an athlete on academic achievement, operationally defined as cumulative grade point average. The basic

generalization that can be made from this small body of research is that, when controls are made for differences in academic aptitude, secondary school achievement, and other salient characteristics, the academic achievement of intercollegiate athletes is approximately the same as their non-athletic counterparts. (American College Testing Program and Educational Testing Service, 1984; Hood, Craig & Ferguson, 1992; Pascarella & Smart, 1991; Smith & Dizney, 1966; Stuart, 1985). Moreover, this parity appears to hold even when the comparison groups are non-athletes and athletes in revenue-producing sports such as football and basketball (e.g., Hood, Craig & Ferguson, 1972; Smith & Dizney, 1966; Stuart, 1985).

Clearly, some substantial problems exist in using college grades as an indication of learning and cognitive development during college. As suggested in a review of the literature by Pascarella & Terenzini (1991), the reliability and validity of grades are threatened by an extensive number of potentially confounding influences. These include the academic selectivity of the institution attended, the student's major field of study, individual course grading patterns, and even professorial style and personality. Because of these potential confounding influences, it is extremely hazardous to make comparisons of student learning or cognitive growth based on college grades, either within or between institutions.

Unfortunately, very little inquiry has estimated the intellectual consequences of intercollegiate athletic participation while employing standardized measures of learning and cognitive development. The evidence that does exist is inconsistent. In

their analysis of the effects of liberal arts education, Winter, McClelland, and Stewart (1981) found that varsity athletic participation was positively linked with gains on a measure of critical thinking in a liberal arts college. Conversely, Astin's (1993) analyses of a large national sample found that athletic participation in college was negatively linked with scores on standardized graduate school admission tests such as the Verbal portion of the Graduate Record Examination, the Law School Aptitude Test, and the National Teachers' Examination.

Because of the national scope of his sample, and the fact that he controls for precollege differences, we tend to give greater weight to Astin's (1993) findings. However, a number of important questions still have not been adequately addressed in the existing research. First, are any negative cognitive effects of intercollegiate athletics the same for all sports or are they largely confined to athletes in revenue-producing sports such as football and basketball? Second, are any cognitive impacts of intercollegiate athletics the same for women as they are for men? Third, are the cognitive impacts of athletics the same for all students, or do they differ for students with different background characteristics (e.g., precollege ability, ethnicity, social origins) and in different institutional contexts (e.g., NCAA Division I versus Non-Division I schools, the average academic ability of the institution's student body).

The present study sought to answer these questions in a longitudinal investigation of the cognitive effects of intercollegiate athletic participation during the first year of

college. Specifically, the study sought to estimate the effects on reading comprehension, mathematics, and critical thinking of athletic participation at 18 NCAA Division I and Non-Division I four-year colleges and universities.

METHOD

Institutional Sample

The initial sample was selected from 18 four-year and 5 two-year colleges and universities located in 16 different states throughout the country. Institutions were selected from the National Center on Educational Statistics IPEDS data base to represent differences in colleges and universities nationwide on a variety of characteristics. These characteristics included institutional type and control (e.g. private and public research universities, private liberal arts colleges, public and private comprehensive universities, two-year colleges) size, location, commuter versus residential, and the ethnic composition of the undergraduate student body. In aggregate, the student population of the 23 schools selected approximated the national population of undergraduates by ethnicity and gender. As this study focused on intercollegiate athletic participation, and since several of the two-year colleges did not sponsor such programs, the analyses we report are based on student samples from the 18 four-year colleges and universities studied.

Student Sample and Instruments

The individuals in the sample were 2416 freshman-year students who participated in the National Study of Student Learning (NSSL), a large, longitudinal investigation of the factors that influence learning and cognitive development in college. The initial sample was, as far as possible, selected randomly from the incoming freshman class at each participating institution. The students in the sample were informed that they would be participating in a national longitudinal study of student learning and that they would receive a stipend for their participation. They were also informed that the information they provided would be kept confidential and would never become part of their institutional record.

The initial, precollege data collection was conducted in the Fall of 1992. The data collection lasted approximately three hours and students were paid a stipend of $25. Students were reminded that the information they provided would be kept in the strictest confidence and that all that was expected of them was that they give an honest effort on tests and a candid response to all questionnaire items. The data collected included a precollege survey that gathered information on student demographic characteristics and background, as well as aspirations, expectations of college, and a series of items assessing their orientations toward learning. Participants also completed Form 88A of the Collegiate Assessment of Academic Proficiency (CAAP). The CAAP was developed by the American College Testing Program (ACT) to assess selected general skills typically acquired by students in the first two years of college (ACT, 1990). The total CAAP

consists of five 40-minute, multiple-choice test modules, three of which--reading comprehension, mathematics, and critical thinking--were administered during the first data collection.

The CAAP reading comprehension test is comprised of 36 items that assess reading comprehension as a product of skill in inferring, reasoning, and generalizing. The test consists of four prose passages of about 900 words in length that are designed to be representative of the level and kinds of writing commonly encountered in college curricula. The passages were drawn from topics in fiction, the humanities, the social sciences and the natural sciences. The KR-20, internal consistency reliabilities for the reading comprehension test range between .84 and .86. The mathematics test consists of 35 items designed to measure a student's ability to solve mathematical problems encountered in many postsecondary curricula. The emphasis is on quantitative reasoning rather than formula memorization. The content areas tested include pre-, elementary, intermediate, and advanced algebra, coordinate geometry, trigonometry, and introductory calculus. The KR-20 reliability coefficients for the mathematics test ranged between .79 and .81. The critical thinking test is a 32-item instrument that measures the ability to clarify, analyze, evaluate, and extend arguments. The test consists of four passages that are designed to be representative of the kinds of issues commonly encountered in a postsecondary curriculum. A passage typically presents a series of subarguments that support a more general conclusion. Each passage presents one or more arguments and uses a variety of formats, including case studies, debates,

dialogues, overlapping positions, statistical arguments, experimental results, or editorials. Each passage is accompanied by a set of multiple choice items. The KR-20 reliability coefficients for the critical thinking test ranged from .81 to .82 (ACT, 1990). In pilot testing various instruments for use in the National Study of Student Learning on a sample of 30 college students the critical thinking test of the CAAP was found to correlate .75 with the total score on the Watson-Glaser Critical Thinking Appraisal.

Each of the 18 institutions was given a target sample size relative in magnitude to the respective sizes of the freshman class at each institution. The overall target sample for the Fall, 1992 data collection at the 18 institutions was 3,910. The overall obtained sample size, (i.e., those students actually tested) for the Fall, 1992 data collection was 3331, or a response rate of 85.19%.

A follow-up testing of the sample took place in the Spring of 1993. This data collection required about three and one-half hours and included an extensive set of measures of the students' freshman-year experience and Form 88B of the CAAP reading comprehension, mathematics, and critical thinking modules. Students were paid a second stipend of $35 for their participation in the follow-up data collection. Of the original sample of 3331 students who participated in the Fall, 1992 testing, 2416 participated in the Spring, 1993 data collection, for a follow-up response rate of 72.53% Given the high response rates at both testings, it is not particularly surprising that the sample was

reasonably representative of the population from which it was drawn. Nevertheless there was some bias. Specifically, women and non-white students were overrepresented. To adjust for the bias, gender and ethnicity were built into the study as potential moderators of the influence of athletic participation. Separate analyses were conducted for men and women, and ethnicity (white versus non-white) was included as a control variable or covariate. The latter permitted us to determine if the impacts of athletic participation were conditional based on student ethnicity.

Of the 2416 students participating in the follow-up testing, complete data for the different analyses conducted in the study were available for between 2391 and 2397 students. There were 860 freshman men in the sample. Based on a question on the NSSL (Spring, 1993) follow-up instrument it was determined that 80 of the men participated in a major, intercollegiate revenue-producing sport (i.e., football or basketball), 102 participated in an intercollegiate sport other than football or basketball, and 678 indicated that they had not participated in an intercollegiate sport during their freshman year. Of the 1537 freshman women in the sample, 203 had played an intercollegiate sport during their freshman year and 1334 had not. Since it is debatable that any women's sports are major revenue-producers, all women intercollegiate athletes were grouped together. Eight of the 18 four-year institutions in the sample were identified as having Division I athletic programs while ten were non-Division I (i.e., Division II or III). Both male and female athletes in the sample were approximately equally divided between Division I and non-

Division I institutions.

Design and Data Analysis

The study design was a pretest-posttest, quasi-experimental design, in which comparison groups were statistically equated on salient Fall, 1992 precollege variables. The comparison groups for men were freshman non-athletes, intercollegiate football and basketball players, and intercollegiate athletes participating in intercollegiate sports other than football or basketball. For women the comparison groups were freshman non-athletes and freshman participants in women's intercollegiate athletics. The dependent variables were Spring, 1993 scores on the CAAP reading comprehension, mathematics, and critical thinking tests. In order to statistically control for precollege and other salient differences between athletes and non-athletes least-squares analysis of covariance was the basic data analytic approach taken. Individuals were the unit of analysis. Guided by the existing body of evidence on the factors influencing learning and cognitive development during college (e.g., Astin, 1968, 1977, 1993; Astin & Panos, 1969; Kuh, 1993; Pascarella & Terenzini, 1991), the individual level covariates in the study were the following:

1. Individual Fall, 1992 CAAP reading comprehension; mathematics, and critical thinking scores [each employed in analysis of the appropriate end-of-freshman year (Spring, 1993) CAAP reading comprehension, mathematics, and critical thinking score].
2. Ethnicity: operationally defined as caucasian/non-

caucasian.

3. Family social origin: the combination of standardized measures of mother's and father's level of formal education and combined family income.
4. Fall, 1992 academic motivation: an eight-item, Likert-type scale (4 = strongly agree to 1 = strongly disagree) with an internal consistency reliability of .65. The scale items were developed specifically for the NSSL and were based on existing research on academic motivation (e.g., Ball, 1977). Examples of constituent items are: "I am willing to work hard in a course to learn the material, even if it won't lead to a higher grade," "When I do well on a test it is usually because I was well prepared, not because the test was easy," "In high school I frequently did more reading in a course than was required simply because it interested me," and "In high school I frequently talked to my teachers outside of class about ideas presented during class."
5. Age: age in years in Fall, 1992.
6. Credit-hours taken: total number of credit-hours for which the student was enrolled during the freshman year.
7. On- or off-campus residence: a dichotomous variable indicating whether the student resided on-campus or lived off-campus and commuted to college.

Because the existing body of evidence suggests that institutional context can often shape the impact of college in indirect, if not direct, ways, we also included two institutional-

level variables as covariates in the analytic model. These were:

8. The level of academic aptitude of the freshman class: estimated by the average fall, 1992 CAAP reading, mathematics, or critical thinking score for the freshman class at each of the 18 institutions. Each student in the sample was given the mean of his or her institution on all three CAAP tests, and each of the institutional mean scores was employed in analysis of the appropriate end-of-freshman year (Spring, 1993) individual-level reading comprehension, mathematics, or critical thinking score.

9. NCAA Division I or Non-Division I institution: Each individual student in the study was coded a "1" if he or she attended an institution classified by the National Collegiate Athletic Association as Division I and a "0" if he or she attended a Non-Division I institution (e.g., Division II or III).

The analysis of covariance for each dependent measure (i.e. end-of-freshman year CAAP reading comprehension, mathematics, or critical thinking score) employed a least-squares regression solution and was conducted in a hierarchical manner. The influence of athletic participation was estimated while controlling for the effects of all nine covariates. The results of this analysis provided estimates of the effects of athletic participation on end-of-freshman year reading comprehension, mathematics, and critical thinking net of, or controlling for, the influence of the covariates. Since precollege (Fall, 1992) reading, mathematics,

and critical thinking were included among the covariates, a significant effect attributable to athletic participation would permit one to conclude that there are significant net differences between athletes and non-athletes, not only in end-of-freshman year reading comprehension, mathematics, and critical thinking, but also in the gains made on those variables during the freshman year (Linn, 1986; Linn & Slinde, 1977; Pascarella & Terenzini, 1991).

In the second stage of the analyses we tested for the presence of covariate x athletic participation conditional effects, one of the assumptions of the analysis of covariance model (Elashoff, 1969; Kerlinger & Pedhazur, 1973). A series of cross-product terms was computed between athletic participation and each of the nine covariates. These were then added to the regression model containing the covariates and dummy variables representing athletic participation (i.e., the main-effects model). A statistically significant increase in the explained variance (R^2) attributable to the set of cross-product terms (over and above the main effects model) would indicate that the net effects of athletic participation differed for individuals at different levels of the various covariates. To determine the nature of such conditional effects, the appropriate dependent variable was then regressed on the covariates separately for athletes and non-athletes. Differences in metric regression coefficients between groups would indicate the nature of the conditional effect.

RESULTS

Table 1 summarizes, by gender, the results of the analyses of

covariance conducted on end-of-freshman year reading comprehension, mathematics, and critical thinking scores. The slight differences in residual degrees of freedom reflect cases dropped from a specific analysis because of missing data. As the Table shows, when statistical controls were made for: individual precollege (Fall, 1992), reading comprehension, mathematics, or critical thinking scores; ethnicity; family social origins; precollege academic motivation; age; credit hours taken; on- or off-campus residence; average precollege reading, math, or critical thinking score for each institution; and the NCAA Division I or Non-Division I status of the institution attended, significant differences were found between male athletes and non-athletes in end-of-freshman year reading comprehension and mathematics. No net differences between male athletes and non-athletes were found on end-of-freshman year critical thinking. Controlling for the same covariates, women athletes and non-athletes differed in end-of-freshman year reading comprehension, but not in mathematics or critical thinking.

Place Table 1 About Here

Table 2 shows, for athletes and non-athletes, the covariate-adjusted means and standard deviations for end-of-freshman year reading comprehension, mathematics, and critical thinking. As the table indicates, for the male sample the significant net differences found between comparison groups on reading comprehension and mathematics were largely between intercollegiate

football and basketball players on the one hand and non-athletes and intercollegiate athletes in non-revenue producing sports on the other. Sheffe' post hoc comparisons (Pedhazur, 1982) indicated that male intercollegiate football and basketball players had significantly lower end-of-freshman year average reading comprehension and mathematics scores than either their counterparts who played other intercollegiate sports or who were non-athletes. Differences between male non-athletes and athletes in sports other than football and basketball were small and non-significant on both reading comprehension and mathematics. There was a similar group trend on the end-of-freshman year critical thinking scale, but as indicated by the analysis of covariance results, differences among group means were non-significant.

Place Table 2 About Here

As Table 2 further indicates, women athletes had significantly lower covariate-adjusted average end-of-freshman year reading comprehension scores than their non-athlete counterparts. There was a noteworthy parity, however, between women athletes and non-athletes on both mathematics and critical thinking.

It is worth noting that the significant differences between athletes and non-athletes in end-of-freshman year reading comprehension and mathematics are modest in magnitude. For example, effect sizes were estimated using the pairwise differences between covariate-adjusted group means, divided by the standard deviation of football and basketball players (e.g., Glass, McGaw, &

Smith, 1981; Light & Pillimer, 1982). Employing this procedure male football and basketball players had a disadvantage of .244 of a standard deviation, relative to non-athletes, in end-of-freshman year reading comprehension, and a disadvantage of .20 of a standard deviation relative to non-athletes in mathematics. Using the area under the normal curve, these convert to net disadvantages for male football and basketball players, relative to non-athletes, of 9.6 percentile points in reading comprehension and 7.9 percentile points in mathematics. In other words, if male non-athletes are performing at the 50th percentile in both reading comprehension and mathematics at the end of the freshman year, football and basketball players with similar traits are performing at about the 40th percentile and the 42nd percentile, respectively, on the same two scales. Compared to male athletes in non-revenue sports, similar male football and basketball players had net disadvantages of .194 of a standard deviation (7.7 percentile points) in end-of-freshman year reading comprehension, and .173 of a standard deviation (6.8 percentile points) in end-of-freshman year mathematics. Women athletes, relative to their non-athlete counterparts, had a net disadvantage in end-of-freshman year reading comprehension of .102 of a standard deviation, or about 4 percentile points.

With the precollege CAAP score as one of the nine covariates controlled statistically, significant differences among athletes and non-athletes in end-of-freshman year cognitive outcomes can be interpreted as significant differences in gains made on those outcomes during the freshman year. [The scaled CAAP scores

analyzed in this study permit such estimations of relative group change over time using alternate forms of the test (ACT, 1990)]. For example, when freshman year changes (i.e., Spring, 1993 CAAP scores minus Fall, 1992 CAAP scores) were the dependent measures, and the same covariates were controlled, the statistical significance of the differences among the three male athlete/non-athlete groups, as well as the post hoc comparisons, were exactly the same as when end-of-freshman year CAAP scores were the dependent variables. On reading comprehension the covariate-adjusted gain scores were: male football and basketball players = -.76; male athletes in other sports = .72; male non-athletes = .72; ($F = 5.50$, $df = 2/857$, $p<.01$). On mathematics the covariate-adjusted gain scores were: male football and basketball players = -.61; male athletes in other sports = .16; male non-athletes = .29; ($F = 4.01$, $df = 2/859$, $p < .025$). As these analyses indicate, male non-athletes and athletes in sports other than football and basketball made modest net gains in freshman year reading comprehension and mathematics, while their counterparts playing football and basketball actually exhibited modest freshman-year declines on both variables.

For women the results using covariate-adjusted freshman year change scores were also exactly the same as when covariate-adjusted end-of-freshman year CAAP scores were the dependent variable. In reading comprehension the net gain for athletes was .52. This was less than half the size of the corresponding net gain made by women non-athletes (1.13); $F = 5.18$, $df = 1/1526$, $p < .025$.

The second stage of the analyses tested for the presence of

covariate x athletic participation conditional effects. For the male sample none of the sets of covariate x athletic participation cross-product terms made a significant ($p < .05$) increase in the explained variance over and above that explained by the main-effects model (i.e., the covariates and the athlete/non-athlete categories). This suggests that for men the significant negative effects of participating in intercollegiate football and basketball on freshman-year reading comprehension and mathematics are general rather than conditional. That is, the negative cognitive effects are the same in magnitude irrespective of the student's position on any of the seven individual covariates (i.e., precollege level of reading, math or critical thinking; ethnicity; age; precollege academic motivation; place of residence; family social origins; credit hours taken). Similarly, the negative cognitive effects of participating in intercollegiate football and basketball were the same in magnitude irrespective of the average freshman class academic aptitude at the institution attended, or whether or not the student attended an NCAA Division I or a Non-Division I school.

For the female sample the sets of covariate x athletic participation cross-products were associated with a significant ($p < .05$) increase in explained variance for both end-of-freshman year reading comprehension and mathematics. To determine the nature of the conditional effects the end-of-freshman year reading comprehension and mathematics scores were regressed on the covariates separately for both female athletes and non-athletes. T-tests for the difference in unstandardized regression coefficients were then used to determine the nature of the

conditional effects (Pedhazur, 1982). In the prediction of end-of-freshman year reading comprehension one significant ($p < .01$) conditional effect was yielded. Specifically, the magnitude of the negative effect of athletic participation varied for women who began college with different levels of reading comprehension. The magnitude of the disadvantage in end-of-freshmen year reading comprehension was largest for women athletes who began college with the relatively lowest reading comprehension and became less pronounced as level of precollege reading comprehension increased. For example, among women below the precollege average reading comprehension score of 62.12, women athletes had a covariate-adjusted end-of-freshman year mean reading score of 58.38. This was 1.51 points, and significantly ($F = 13.49$, $df = 1/810$, $p < .001$), lower than the corresponding score of women non-athletes (59.89). The end-of-freshman year reading disadvantage for women athletes below the mean precollege reading score of 62.11 was .26 of a standard deviation or 10.26 percentile points.) Conversely, women athletes above a precollege reading score of 62.11 had a covariate-adjusted end-of-freshman year mean reading score of 66.78. This was only .43 points below that of women non-athletes (67.21), and the difference was non-significant ($F = 1.71$, $df = 1/705$, $p > .19$).

In the prediction of end-of-freshman year mathematics for the female sample one significant ($p < .025$) conditional effect was also uncovered. Specifically, the magnitude of the effect of athletic participation on women's mathematics knowledge differed by age. Among women below the mean age of entering freshmen, athletes

demonstrated somewhat higher end-of-freshman year mathematics knowledge than their non-athlete counterparts. Conversely, above the mean age of entering freshmen a modest advantage in mathematics knowledge was demonstrated by non-athletes. None of these group differences, however, was statistically significant. Consequently we are hesitant to advance a substantive interpretation of this conditional effect.

CONCLUSIONS AND IMPLICATIONS

The findings of this eighteen institution study suggest that intercollege athletic participation has significant consequences for the general cognitive development of both men and women during the first year of college. By the end of their freshman year male intercollegiate football and basketball players were significantly disadvantaged, relative to both male non-athletes and male athletes in sports other than football and basketball, on standardized measures of reading comprehension and mathematics. This significant disadvantage persisted even after controlling for important individual traits (i.e., precollege reading comprehension and mathematics, precollege academic motivation, age, ethnicity, family social origins, credit hours taken during the freshman year, and on- or off-campus residence) and institutional characteristics (i.e., the average entering reading comprehension and mathematics score of the institution's freshman class and whether the student attended an NCAA Division I or Non-Division I institution). There was a general parity between male non-athletes and male athletes in non-revenue sports on both reading comprehension and mathematics.

The same pattern of net disadvantage for football and basketball players was shown on end-of-freshman year critical thinking, although the disadvantage was not large enough to be statistically reliable.

As previously shown, the significant net disadvantage in end-of-freshman year reading comprehension and mathematics for male football and basketball players is the equivalent of saying that their pattern of development or change on those two cognitive dimensions is significantly different than either their counterparts in other sports or male non-athletes. Indeed, while the latter two groups made small net gains in reading comprehension and mathematics during the freshman year, football and basketball players demonstrated net loses on both cognitive dimensions. It is important to underscore that, although the relative net disadvantages in cognitive growth accruing to male football and basketball players were modest in magnitude (.24 of a standard deviation in reading and .20 of a standard deviation in mathematics), they were nevertheless discernible by the end of the first year of college. Given ample evidence of how initial disadvantages become cumulative over time (e.g., Merton, 1968; Walberg & Tsai, 1983; Walberg, Strykowski, Rovai & Hung, 1984), one might anticipate that such modest freshman year disadvantages would become more pronounced during the course of one's college career.

Our analyses of male athletes and non-athletes also found that the cognitive disadvantages accruing to football and basketball players tended to be general rather than conditional. That is, the relatively lower levels of freshman-year reading comprehension and

mathematics development tended to be the same in magnitude irrespective of the student's precollege reading comprehension or mathematics preparation, precollege academic motivation, age, ethnicity, family social origins, freshman credit hours taken, or on- or off-campus residence. Similarly, we found no reliable evidence to suggest that the negative cognitive impacts of participating in intercollegiate football and basketball differed in magnitude for men who attended Division I or Non-Division I institutions, or who attended institutions varying in the entering reading and mathematics abilities of their student bodies.

The analyses for women showed somewhat less pronounced and extensive general effects than those for men. Net of the influence of the individual and institutional level covariates, women athletes showed significantly less freshman year development in reading comprehension than their non-athlete counterparts. The two groups were essentially the same in mathematics and critical thinking. While the overall mean disadvantage in freshman-year reading comprehension for women athletes was quite modest in size (.10 of a standard deviation, 4 percentile points), it was also misleading. The impact of athletic participation on freshman year reading comprehension was not the same for all women, but rather varied in magnitude for women who entered college with initially different levels of reading ability. The largest net reading comprehension disadvantages accrued to those women athletes who began college with the lowest levels of reading comprehension. As level of precollege reading comprehension increased, the magnitude of the disadvantage for women athletes, relative to their non-

athlete counterparts, tended to decrease. For example, among women below the precollege reading mean for all women, the disadvantage in freshman-year reading comprehension for athletes relative to non-athletes was .26 of a standard deviation or about 10.3 percentile points. This was about 3.5 times the magnitude of the relative disadvantage for women athletes above the precollege mean.

Such findings suggest that, where intercollegiate athletic participation has a negative influence on the cognitive development of women, the nature of that influence results in a cumulative disadvantage. That is, the cognitive penalties linked with athletic participation are not the same for all women, but rather are most pronounced for those women who are at the greatest disadvantage to begin with. Moreover, if the evidence on cumulative disadvantage holds for the present sample, one might anticipate that the relatively lower levels of freshman-year reading comprehension exhibited by the initially least well-prepared women athletes would become more, rather than less, pronounced over time (e.g., Pascarella, Brier, Smart & Herzog, 1987; Walberg & Tsai, 1983).

Given that development during college is often the cumulative result of a broad range of mutually reinforcing academic and non-academic experiences that extend over time (e.g., Pascarella & Terenzini, 1991), it is difficult to isolate the specific causes that contribute to the above findings. Clearly, one cannot dismiss the often extensive time commitment required of intercollegiate football and basketball players, or the possible attendant development of a subculture that may not always value reading or

study. However, other hints are suggested by the various experiences of athletes during the freshman year. For example, compared to male non-athletes, intercollegiate football and basketball players in our sample tended to take a greater portion of their freshman year coursework in applied/preprofessional areas such as physical education, speech pathology or child and family studies. Such a coursework emphasis has been shown to have little or no positive relationship to gains in standardized freshman year reading comprehension or mathematics (Bohr, in press). Supporting this evidence is the fact that male football and basketball players also reported reading fewer texts or assigned books.

A somewhat consistent pattern was also shown for the relative coursework emphasis of women athletes and non-athletes. Compared to their non-athlete counterparts, women intercollegiate athletes took a greater portion of their freshman year coursework in applied/pre-professional areas (e.g., speech pathology, education, physical education, physical therapy, child and family studies). It is interesting to note that while women athletes took fewer courses in algebra than non-athletes they took a greater number of courses in geometry, matrix algebra, and computer science. Consistent with this, there was an essential parity between women athletes and non-athletes in freshman year gains in mathematics.

There is, of course, another perspective from which to view the findings of the study. The significant disadvantages for athlete groups in freshman-year reading comprehension and mathematics did not extend to critical thinking. Net of the influence of the individual and institutional-level covariates,

both male and female athletes gained about the same in critical thinking during the freshman year as their non-athlete peers. Two explanations might be advanced for this parity between athletes and non-athletes. The first is that intercollegiate athletic competition may actually provide a set of experiences during college that are potentially rich in their capacity to foster adaptive and critical thinking processes (Pascarella & Terenzini, 1991). As suggested by Winter, McClelland and Stewart (1981, p. 134) in their study of the collegiate experiences influencing student intellectual development:

> Success in athletics [requires] at least two qualities of mind: disciplined thorough practice and adaptability to complex and rapidly changing circumstances. Applied to mental life, this practice and adaptability should enhance a person's ability to form and articulate abstract cognitive concepts to organize complex experience. (Thus coaches in many sports, for example, speak of a player's ability to diagnose or "read" the other team's intentions or the course of the game.)

A second potential contributing factor is that, in comparison to growth in reading comprehension and quantitative skills, the development of critical thinking may be tied less to specific coursework or curricular experiences. Indeed, the body of evidence on the development of critical thinking and related intellectual capabilities suggests that they may be most influenced by the breadth of one's social, extracurricular, and intellectual engagement during college (Kuh, 1993; Ory & Braskamp, 1988; Pace,

1987, 1990; Pascarella, 1989). We found little consistent evidence that male football or basketball players or male athletes in other sports had any less breadth of involvement during the first year of college than their non-athlete peers. Women athletes were actually somewhat more broadly engaged in college than women non-athletes. For example, women athletes were significantly more likely to report that they: made friends with people with different majors, interests, and backgrounds; participated in late night discussions; participated in class discussions; discussed career plans with faculty; studied with other students; and changed their opinion after discussion. Clearly the structural factor that most directly fosters a student's breadth of involvement in college is living on-campus (e.g., Chickering, 1974; Pascarella & Terenzini, 1991), and residential living was more likely in our sample of institutions if one was an intercollegiate athlete.

The findings of this study, then, present a picture of the cognitive effects of intercollegiate athletic participation that is complex, both in terms of different kinds of athletic participation and the pattern of outcomes influenced. Clearly male football and basketball players at both Division I and Non-Division I schools are an outlier group. In terms of net cognitive gains in both reading comprehension and mathematics during the first year of college, they differ not only from non-athletes, but also from athletes in other sports. The latter two groups, however, were virtually indistinguishable from each other on all three outcomes considered (i.e., reading comprehension, mathematics, and critical thinking).

The effects of athletic participation for women appeared less pronounced and extensive than those for men. The only net disadvantage for women athletes was in reading comprehension gains, and that was small. It was also misleading, however, because the disadvantage in reading gains for women athletes entering college with the lowest levels of reading comprehension was substantially larger than the disadvantage found for women athletes in general. Such a finding further underscores the fact that intercollegiate athletes may be a diverse group, and that the individual aptitudes and characteristics they bring to college can have important implications for the impact of athletic participation on their development. It also underscores the importance of considering such conditional influences in future research on the impacts of intercollegiate athletic participation.

The findings also suggest that the cognitive impacts of intercollegiate athletic participation are selective rather than global. The net disadvantages for athletes in this study were concentrated in areas that are perhaps most closely tied to coursework and the rigor of the student's academic experience (i.e., reading comprehension and mathematics). We found little consistent evidence to suggest that athletes make smaller freshman year gains than their non-athlete peers on a more general index of cognitive development (i.e., critical thinking).

Finally findings of this study have several practical implications for both academic and athletic programs. The first stems from the finding that male intercollegiate football and basketball players experience net declines in reading comprehension

and mathematics during their freshman year while athletes in other sports and non-athletes show net gains. Although it is difficult to isolate the specific sources of this disadvantage, the findings indicate that male football and basketball players (compared to the other two groups) take more courses in fields of study (primarily applied, pre-professional, or professional) that may place a lower emphasis on reading and math. Moreover, football and basketball players also report reading fewer texts and assigned books than their peers. The learning disadvantages associated with participation in these sports might be ameliorated through academic advising that guides football and basketball players into more courses in the humanities, social sciences, and physical and natural sciences that may be more likely to emphasize and promote their reading and quantitative skills.

In addition, while it cannot be determined from the evidence in this study, intercollegiate football and basketball for men may constitute a campus subculture that attaches a lower value to reading and math skills than is the case for other intercollegiate sports or for a campus in general. If future research shows this speculation to be reasonably accurate, then it would call into question the educational value of concentrating intercollegiate football and basketball players in the same residence facility. That this learning disadvantage was identifiable after the first year of college, moreover, also raises questions about the educational wisdom of allowing freshmen to participate in varsity level intercollegiate football and basketball.

Second, the negative learning impact on males associated with

participation in football and basketball may not be a phenomenon specific to "Big-Time Sports" schools. In this study, the effects were as likely to be found on NCAA Division II and III campuses as at Division I schools. Moreover, the negative effects were as likely to occur at campuses enrolling new students with high pre-college reading and math scores as at campuses with new students scoring lower on both of these measures. These findings suggest that the negative cognitive effects on males of participation in football and basketball may be endemic to the sports themselves rather than to the nature of the campuses fielding teams in those sports. There can be little doubt that the football and basketball programs at Division I institutions (compared to Division II and III schools) attract on average more highly skilled players, give those programs greater campus and public visibility, and invest and generate larger sums of money. One might speculate, however, that the time demands on football and basketball players may be about the same across NCAA divisions. And since time is a finite commodity, less time is available for academic activities. (It cannot be determined from this study, however, whether the time demands of playing intercollegiate football or basketball players are, in fact, greater than those of other sports.) Moreover, as noted earlier, it may also be that football and basketball teams constitute campus subcultures that attach less value to academic achievement than do other sports. Thus, the degree of emotional or financial resources invested in football and basketball may be a less salient factor than either or both the temporal demands placed on the players and the intrinsic value attached to learning within

these subcultures.

Third, the findings of this study suggest a need for athletic and academic administrators to pay closer attention to the pre-college reading skills of female athletes. The evidence indicates that women athletes are at a net disadvantage in first-year reading gains relative to their non-athlete peers. This disadvantage was greatest, however, for those female athletes with the lowest initial reading scores. If athletic participation is not to further penalize these young women, then potential reading problems must be detected earlier in their college careers (e.g., at time of entry) and steps taken to develop those skills as quickly as possible, either through remediation or regular course work.

Finally, the apparent learning disadvantages accruing to males who play intercollegiate football and basketball, and to female intercollegiate athletes with low pre-college reading skills, suggest that any steps taken to ameliorate these negative influences need to be taken early in these students' collegiate careers. As suggested above, the negative influences of athletics for these groups were detectable in this study after only one year of collegiate athletic participation. A growing body of evidence suggests these one-year differences may well be the first stage in a process that produces a cumulative disadvantage, one that is likely to grow worse over time.

LIMITATIONS

Clearly this study has limitations that should be kept in mind when interpreting the findings. First, although the sample is

multi-institutional and consists of a broad range of institutional types from around the country, it should not necessarily be regarded as a nationally representative sample. Similarly, although attempts were made in the initial sampling design to make the sample as representative as possible at each institution, the time commitment required of each student participant undoubtedly led to some self-selection. We cannot be sure that those who were willing to participate in the study responded in the same way as those who were selected but declined to participate in the study. Third, while we looked at three different measures of cognitive development in college (reading comprehension, mathematics and critical thinking) these are certainly not only dimensions along which students develop intellectually during the college years. Alternative conceptualizations and assessment of cognitive development might yield results different from those yielded by this investigation. Finally, this study is limited by the fact that it was only able to trace the cognitive growth of athletes and non-athletes over the first year of college. Whether the same pattern of effects would persist over a longer period of time is certainly an important area for additional research.

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TABLE 1

ANALYSIS OF COVARIANCE SUMMARIES
OF THE EFFECTS OF FRESHMAN YEAR INTERCOLLEGIATE ATHLETIC PARTICIPATION ON END-OF-FRESHMAN YEAR READING COMPREHENSION, MATHEMATICS, AND CRITICAL THINKING

GROUP	Reading Comprehension		Mathematics		Critical Thinking	
SOURCE	df	F	df	F	df	F
MEN						
Covariates*	9	157.33**	9	213.48**	9	164.68**
Intercollegiate Athletic Participation	2	5.50**	2	4.01*	2	1.05
Residual	846		848		845	
WOMEN						
Covariates*	9	280.97**	9	348.24**	9	274.48**
Intercollegiate Athletic Participation	1	5.18*	1	0.09	1	0.02
Residual	1526		1526		1523	

*Individual Fall, 1992 reading, math, or critical thinking score; Average Fall, 1992 reading, math, or critical thinking score for each institution; Ethnicity; Family social origins; Fall, 1992 academic motivation; Age; Freshman year credit hours taken; On-or off-campus residence; NCAA Division I or Non-Division I institution.

*$p < .025$
**$p < .01$

TABLE 2

COVARIATE-ADJUSTED MEANS AND STANDARD DEVIATIONS
FOR END-OF-FRESHMAN YEAR READING COMPREHENSION, MATHEMATICS, AND CRITICAL THINKING

GENDER	Reading Comprehension		Mathematics		Critical Thinking	
GROUP*	M	SD	M	SD	M	SD
MEN						
Non-Athletes	63.39[a]	5.87	60.12[c]	4.75	63.30	5.98
Participated in Intercollegiate Football or Basketball	61.91[b,c]	6.07	59.22[c,d]	4.50	62.65	6.15
Participated in an Intercollegiate Sport other than Football or Basketball	63.09[a]	6.04	60.00[c]	4.93	63.27	6.09
WOMEN						
Non-Athletes	63.24[a]	5.69	58.76	4.34	63.12	5.84
Participated in Intercollegiate Athletics	62.63[a]	5.97	58.70	4.54	63.15	5.95

*Within each gender and dependent measure similar letter superscripts indicate significant pairwise differences between covariate-adjusted group means at $p < .05$.